

REMARKS

Claim 239 is amended herein. Claims 1-207 were previously canceled. Claims 221-233 are withdrawn from consideration. Support for the amendment is found, for example, on page 19, lines 23-24 of the original specification. Hence no new matter is added. Accordingly, Applicants respectfully request entry of the Amendment.

I. Claim Rejections

A. The Examiner's Position

1. Claims 208-213, 215, 217-220, 235, 236 and 238-239 under 35 U.S.C. § 103

Claims 208-213, 215, 217-220, 235, 236, 238 and 239 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Tanaka et al. (WO 97/11518) in view of Takeuchi et al. (5,239,188) and Ohba et al. (5,656,832).

2. Claims 214 and 216 under 35 U.S.C. § 103

Claims 214 and 216 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Tanaka et al. (WO 97/11518) in view of Takeuchi et al. (5,239,188) and Ohba et al. (5,656,832), and further in view of Tischler et al. (5,679,152).

3. Claims 234 and 237 under 35 U.S.C. § 103

Claims 234 and 237 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Tanaka et al. (WO 97/11518) in view of Takeuchi et al. (5,239,188) and Ohba et al. (5,656,832), and further in view of Harunori et al. (JP 7-201745).

B. Applicants' Response

Applicants respectfully traverse the rejection and submit that the cited references do not teach or suggest the presently claimed invention, whether taken alone or in combination, for the following reasons.

Tanaka et al and Takeuchi et al (US 5,239,188) both disclose Epitaxial Lateral Overgrowth (ELO), and Ohba et al (US 5,656,832) discloses forming an off-angle on a substrate. However, Ohba discloses a very broad range of 0.5 to 10° for forming an off angle with respect to the C-plane to a sapphire substrate and does not disclose nor suggest the specific application of such an off-angle to a “dissimilar” substrate, as in the claimed invention. Thus, one of ordinary skill in the art would not have been motivated to modify or combine Tanaka et al and Takeuchi et al with a reasonable expectation of success in achieving the claimed invention. Tischler et al nor Harunori et al cure the deficiencies of Tanaka et al, Takeuchi et al and Ohba et al. Thus, the claimed invention is not rendered obvious over the cited references.

Further, the present invention provides a solution to the problems associated with employing ELO on a “dissimilar” substrate. In the case of growing GaN on a dissimilar substrate, cracks would not be formed in the growth. However, in case of growing ELO on a dissimilar substrate, cracks would be formed inside the GaN crystal, unless off-angle were applied on the dissimilar substrate as in the present invention.

Neither Tanaka nor Takeuchi discloses, teaches, suggests or mentions such an off-angle formed on the dissimilar substrate, and therefore it would not have been obvious for one of ordinary skill in the art to employ off-angle allocation on the dissimilar substrate.

Further, as discussed above, Ohba et al discloses a very broad range of 0.5 to 10° for forming an off angle with respect to the C-plane to a sapphire substrate and does not disclose or suggest the specific application of such an off-angle to a “dissimilar” substrate, as in the claimed invention. It has been established that a variable must be recognized as contributing to a specific result before it can be acknowledged as *prima facie* obvious to determine the optimum or workable range of the variable. In this case none of the cited references recognizes the advantages of such an off-angle when growing ELO on a dissimilar substrate. Thus, even if the references were combined as suggested by the Examiner, one of ordinary skill in the art would not have had a reasonable expectation of success in achieving the claimed invention.

II. Unexpectedly Superior Results of the Claimed Invention

The present invention also provides unexpectedly superior results over the prior art based on a comparison of the prior art to the claimed invention as shown in the attached Figures A1, A2, B1 and B2.

Attached Figures A1 and A2 are electron micrographs showing the surface of GaN layer grown laterally on the C-plane of a sapphire substrate, i.e., conventional art. Fig. A1 is an optical microscope image of 50x magnification and Fig. A2 is a fluorescence microscope image of 1,000x magnification.

In Fig. A1, abnormal morphology in various minute hexagonal shapes appears on the surface of the GaN layer. Fig. A2 shows the stripe pattern of lateral growth, and the black portion shown in this figure (as indicated by the red arrow) is a portion with high intensity of penetrating dislocations.

Thus, Figs. A1 and A2 show that a portion with reduced penetrating dislocations is created in parallel stripes shape, while larger internal cracks run in the diagonal directions of hexagonal shape. Such crystal defects have an adverse effect on the production of devices such as the semiconductor laser formed on this substrate.

In contrast, Figs. B1 and B2 are electron micrographs showing the surface of a GaN layer grown laterally on the main surface approximately 0.2° off-angled from the C-plane of a sapphire substrate, i.e., according to the present invention. Fig. B1 is an optical microscope image of 50x magnification and Fig. B2 is a fluorescence microscope image of 1,000x magnification.

In Fig. B1, it can be seen that the minute hexagonal patterns disappear unlike Fig. A1, thereby achieving a better surface morphology. Also, Fig. B2 shows better crystallinity without internal cracks.

Accordingly, the present invention reduces penetrating dislocation by forming off-angles and growing a nitride-based semiconductor laterally on the main surface, as well as reducing abnormal morphology and internal cracks, resulting in a nitride-based semiconductor with better crystallinity. Thus, the present invention provides unexpectedly superior results over the prior art.

III. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the

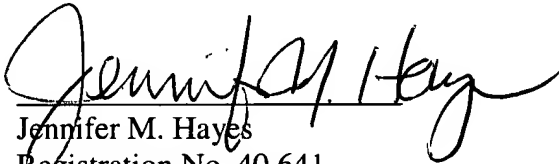
AMENDMENT UNDER 37 C.F.R. § 1.111
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Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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